Diffractive Heavy Pseudoscalar-Meson Productions by Weak Neutral Current

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Hard diffractive lepto-production of heavy vector-mesons ($J/\psi T$) at HERA have offered a unique opportunity to measure directly the gluon distribution in the proton, especially at very small x. In fact, abundant data of the vector-meson productions at HERA as well as DIS has provided a useful constraint for the small-x behavior of the gluon distribution function [1]. Once the gluon distribution is thus fixed, we can expect new physics from other diffractive processes assuming they are dominated by the exchange of two Reggeized gluons (Pomeron). In this talk we focus on the diffractive pseudoscalar-meson production o. the proton by weak neutral current, i.e., $\nu + p \rightarrow \nu' + \eta_{c(b)} + p'$ [2]. This is the first theoretical work based on pQCD to study the neutrino induced diffractive processes. Use of the neutrino beam allows us to observe the pseudoscalar-mesons in the final state via the Z^0-boson exchange. In particular, the possible production of η_b would give a chance to clarify the level scheme of η_b's. It exhibits a striking difference from the diffractive process with the electron beam, which cannot produce pseudoscalar mesons at lowest order, although at higher order it would be possible through the three Reggeized gluon exchange (Odderon)[3], for which there is presently no evidence from the data. By constructing light-cone wave functions of Z^0 and $\eta_{c(b)}$, we calculate the total cross sections of the $\eta_{c(b)}$ productions in the dipole approximation and eikonal approximation (Fig.1). Our analysis shows that the dominant contributions to the cross-section come from the axial-vector coupling of Z_0 - $Q\ \bar{Q}$ ($Q = c, b$) with the Z_0 polarization being scalar. We also evaluate that the overlap integral of the axial-vector Z_0 wave function with that of $\eta_{c(b)}$ is much larger than that of the corresponding vector part with that of J/ψ. As a result, in the neutrino induced diffractive processes the η_c cross-section is much enhanced compared with the J/ψ production (Fig.2).

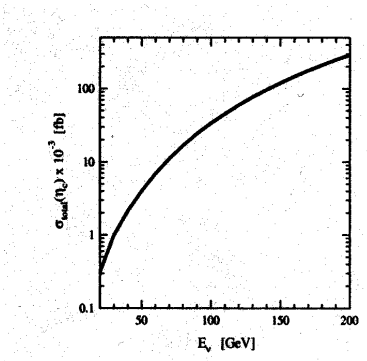

Figure 1: Total cross section of η_c.

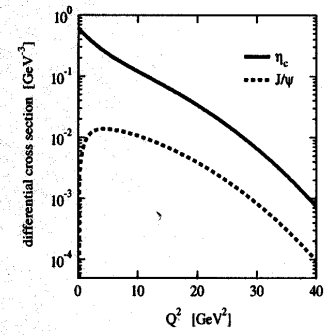

Figure 2: Q^2-dependence of η_c compared with J/ψ

References

[1] K. Suzuki *et al.*, Phys. Rev. **D62**(2000) 031501(R) and references therein.
[2] A. Hayashigaki, K. Suzuki and K. Tanaka, in preparation.
[3] J. Czyzewsky *et al.*, Phys. Lett. **B398**(1997) 400.